Physiology of Speech

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ILOs

- Define speech.
- List the types of speech (spoken & written).
- Describe the mechanism of speech.
- List the types, and mechanisms of speech disorders (Aphasia & Dysartheria).

Speech

It is the means of communication between persons

It is the ability to express words (spoken or written) in response to visual and auditory stimuli.

It is the highest cortical function. It is the function of the categorical hemisphere.

Communication has 2 aspects:

Sensory (language input), involving the ears and eyes

Motor (language output), involving vocalization and writing

Aspects of Communication

I. Sensory centers

II. Motor centers

Sensory Aspects of Communication

For comprehension

I. Visual association area

Site: The occipital lobe.

Function: Understanding of the meaning of written words.

II. Auditory association area

Site: The temporal lobe.

Function: Understanding of the meaning of spoken words.

III. Werinke's area

Sensory center of speech

Site: Posterior part of the superior temporal gyrus in the categorical hemisphere.

Function:

1- Comprehension of the thoughts of visual and auditory information.

2- Determination of thoughts to be expressed.

3- Choice of proper words to be used.

Motor Aspects of Communication

For expression

I. Broca's area = Word formation area

Motor center of speech

Site: Frontal lobe in the lower part of the premotor area (area 6).

Function:

- Formation of words (speaking ability)
- Stores programs of the spoken words = sequence of coordinated contractions of lips, tongue and laryngeal muscles.

It sends this pattern via a speech articulation area in the insula to the motor cortex (face and laryngeal regions) → corticobulbar tract → which initiates the appropriate movements of the lips, tongue, and larynx to produce spoken words.

II. Exner's area = Hand skills area

Site: It is present in frontal lobe in the upper part of premotor area (area 6).

Functions:

- Stores program of the written words = sequence of coordinated contraction of the hand muscles.

It sends this pattern to hand region in the motor cortex → corticospinal tract → written words.

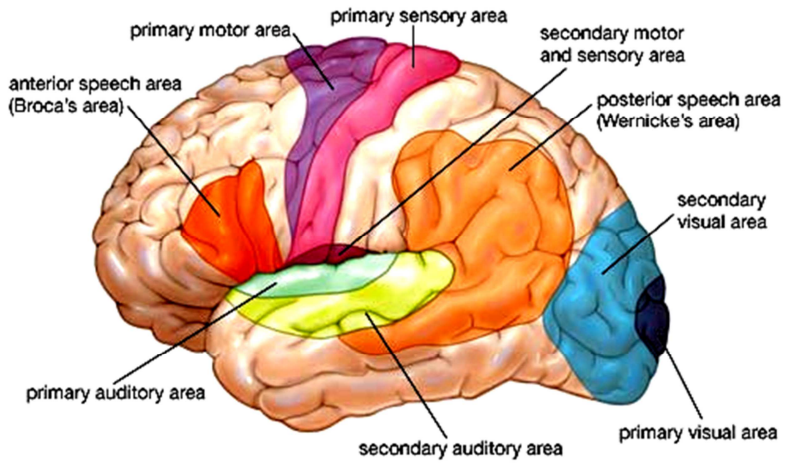

Figure (1): Speech centers

Mechanism of speech

Spoken speech

- Perception of spoken words occurs in primary auditory area which discharges to auditory association area where interpretation of individual words occurs.
- In Wernicke's area, comprehension of auditory information and determination of the thoughts and the words to be spoken occur.
- Transmission of signals from Wernicke's area to Broca's area occurs by way of the arcuate fasciculus.
- In Broca's area: skilled motor programs for control of word formation are activated.
- Transmission of signals to the motor cortex to stimulate the speech muscles resulting in act of articulation.

Written speech (reading)

- Perception of written words occurs in primary visual area which discharges to visual association area where interpretation of individual words occurs.
- Then, the information passes to the angular gyrus which is located behind Wernicke's area and appears to process information from words that are read in such a way that they can be converted into the auditory forms of the words in Wernicke's area.
- Finally reaches its full level of comprehension in Wernicke's area.
- From here, the sequence is the same as for spoken speech.

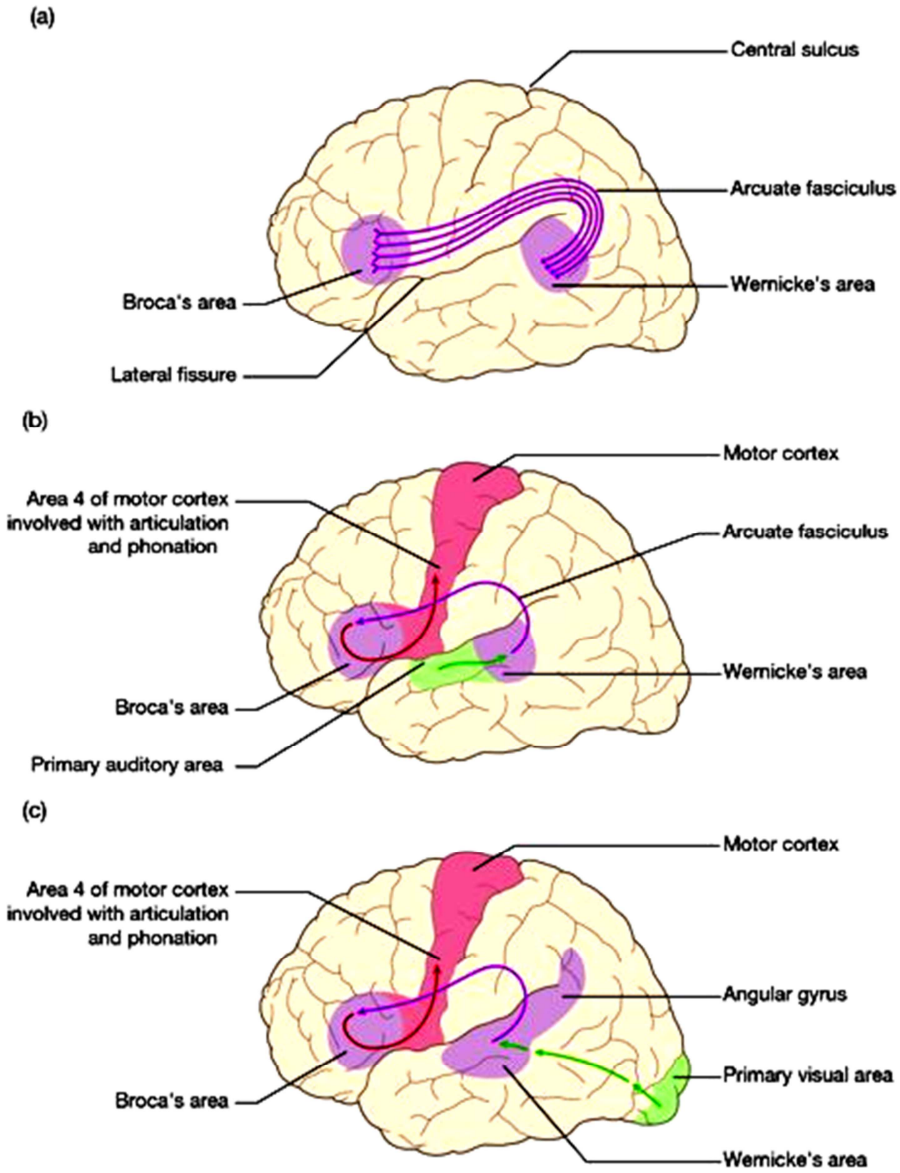

Figure (2): Mechanisms of speech
b) For spoken words c) For written words

Speech disorders

- Aphasia
- Dysartheria

A. Aphasia

- Are abnormalities of language functions that not due to defects of vision or hearing or motor paralysis.
- They are caused by lesions in categorical hemisphere.

- The most common is embolism or thrombosis of a cerebral blood vessel.

1. Sensory aphasia = receptive aphasia = fluent aphasia
2. Motor aphasia = expressive aphasia = non fluent aphasia
3. Global (general) aphasia

I. Sensory aphasia

1. Visual aphasia = word blindness

Lesion: Visual association area.

Patient can see the written words but cannot understand their meaning.

2. Auditory aphasia = word deafness

Lesion: Auditory association area.

Patients can hear the spoken words but cannot understand their meanings.

3. Wernike's aphasia

Lesion: Wernike's area.

Patient fails to comprehend the idea and thoughts conveyed by the spoken or written words (patient is unable to grasp the meaning of the words). Patient talks excessively but what they say make no sense. So, he cannot form thoughts or choose appropriate words to convey their thoughts.

Conductive aphasia:

A type of fluent aphasia in which patient can speak well and has good auditory comprehension but cannot put parts of words together, conjure up words or repeat phrases or words correctly.

It was believed to be due to lesion in the arcuate fasciculus but now it appears to be due to lesions near the auditory cortex.

Anomic aphasia:

It is due to damage in the angular gyrus in the categorical hemisphere without affecting Wernicke's or Broca's areas.

Patient finds difficulty in naming seen objects only. No difficulty in speech or understanding auditory information but patients is unable to understand written words and pictures because visual information is not processed and transmitted to Wernicke's area.

II. Motor aphasia

1. Broca's aphasia

Lesion: Broca's area.

Patient understands the meaning of the spoken and written words but he cannot express himself by spoken words although he knows what he wants to say! (speech is slow, hard to come and limited to two or three words only).

2. Agraphia

Lesion: Exner's area hand skills area.

Patient understands the meaning of the spoken and written words but he cannot express himself by written words, although he knows what to write!

III. Global (general) aphasia

It occurs in extensive brain lesions involving both receptive and expressive functions. Speech is scant and nonfluent.

B. Dysartheria

It is abnormality of speech due to defect in act of articulation.

Types and Causes:

1. Spastic dysartheria due to UMNL giving slow labored stiff speech
2. Flaccid dysartheria due to LMNL giving weak breathy nasal speech.
3. Ataxic dysartheria due to Neocerebellar lesion (lack of coordination) giving staccato speech.
4. Hypokinetic dysartheria due to Parkinsonism giving slow monotonous low volume speech.
5. Hyperkinetic dysartheria due to damage of basal ganglia causing quick involuntary movement (bursting speech)
6. Mixed dysartheria